DISCOVERY

Impact of railway traffic activities on growth of *Pithecellobium dulce* Roxb. Benth

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ABSTRACT

The rail transport is an important mode of land transportation for cargo goods and public. The railway transportation activities release different types of pollutants in environment and produce toxic effects on soil and plant at regional and global levels. In recent years, the quality of air, water and soil has changed rapidly by locomotive pollution in developing countries. The environment quality, soil properties and vegetation cover near railway track of Karachi city, is under abiotic stress challenges due to railway activities. It is important to investigate the effect of railway activities on soil near railway track. In this study, the seedling growth characteristic of *Pithecellobium dulce* raised in site B soil significantly $p<0.05$ decreased. Moreover, it would provide the toxic and beneficial impact of close to railway site soil on woody plant species, *P. dulce* is a challenging task. The results suggest that the soil of D and E site was suitable for seedling development of *P. dulce*.

Keywords: Leaf growth, leaf numbers, root length, railway transportation, soil contamination, yield

1. INTRODUCTION

The railway network provides an economical mode of transportation of public and cargo goods as compared to movement by other types of automobiles on land surface. Railway transport operation is well known environmental pollution issue as influence on the ecology of area (Jiasheng et al., 2020; Brtnický et al., 2022). The researchers have published some scientific data considering the contamination of nearby soil railway track due to railway activities (Bosso et al., 2019) with some socio-economic advantages (Gao et al., 2022; Roshan et al., 2022) and risk to environment (Omar et al., 2023). In recent times the railway activities influence on the native and non-native plant (Łapok et al., 2018). The air quality in railway stations quantified (Lalive et al., 2018; Yang et al., 2021) and found environmental damage. The exhaust emission from locomotive engine release various types of pollutants likewise carbon compounds, nanoparticle, particulate matter, NO_2, heavy metals affecting quality of soil, negative impact on natural environment, climate change and plant growth (Shafiq and Iqbal, 2019; Radziemska et al., 2020; Lima et al., 2021; Cui et al., 2022; Rak et al., 2022; Pu et al., 2023). The concentrations of degradation product close to railways in Sweden

DISCOVERY SCIENTIFIC SOCIETY

were detected with exceeding the European Union quality standard for ground water quality and disturbed vegetation (Cederlund, 2022).

After the discharge of pollutants from the locomotive engine settled on the soil near to railway track and ultimately responsible for lowering the quality of soil and plant growth. There is a growing demand to increase the vegetation covers for preservation of environment due to railway activities. This paper gives information about the state of the city environment is deteriorating due to rapid increase in urbanization, industrialization, automobiles including railways activities rapidly during last two decade. *P. dulce* is a medium size multipurpose fast growing shrub species in the family of Fabaceae. The individuals can grow upto 20 m, native to Mesoamerica, cultivated in all over the plains of India and Pakistan (Barneby and Grimes, 1997; Sivakumar and Murgesan, 2005; Sugumaran et al., 2008; EOL, 2020; Datiles and Acevedo-Rodriguez, 2022) and commonly known as Jungal Jalebe in Urdu.

The soil close to railway tracks becoming vulnerable to vegetation due to emission from locomotive and settling of pollutants on the soil. The soil of such area is one of the most important media for pollutant deposition. There is no research work reported on the effect of railway transport affected soil for *P. dulce*. Therefore, considering the importance of railway activities this research was investigated to record and compare the impact of railway transportation using soil of close to railway track on *P. dulce*.

2. MATERIALS AND METHODS

The comparative research study on plant development was carried out at Department of Botany, University of Karachi, Pakistan. The soil surface samples close to railway track viz. Karachi Cantonment, Malir, Drighroad, Landhi Railway and Karachi University Campus from 30 cm were collected. The composite soil was air dried. These were passed through 2.0 mm sieve. A sufficient amount of seeds of *P. dulce* were taken from the species growing in Karachi University Campus. The seeds of *P. dulce* were sown in large pots with garden loam for two weeks. The equal height germinated plants were transferred in pots size of 20 X 9.80 cm for the treatment to the selected soil. The irrigation done by tap water and five replicates was used for each seedlings treatment.

In the design of experiment, the completely randomized was used. The reshuffling of pots was done to prevent from any environmental effect such as light and shade. The uprooted seedlings from pots were washed with water after eight weeks to record the seedling growth parameters. Later on, these plants material was oven dried at 80 ºC to get constant seedling dry biomass after 24 hours by electrical balance. The generated experimental data were evaluated by standard statistical technique by ANOVA and the difference between means by Duncan's Multiple Range Test was analyzed at level <p0.05 of significance using statistical software COSTAT version 3.

3. RESULTS AND DISCUSSION

Corfa et al., (2004) is taken into account about the impact of emission from a diesel "locomotive" on air quality. This paper is in continuation of series of our research work performances on the influence of railway activities on regional flora and quality of soil. In this research study, the examined soil substrate showed significantly p<0.05 impact on seedling height, leaves number, circumference and yield production of *P. dulce* as compared to University Campus responded differently (Figure 1, 2) (Table 1).

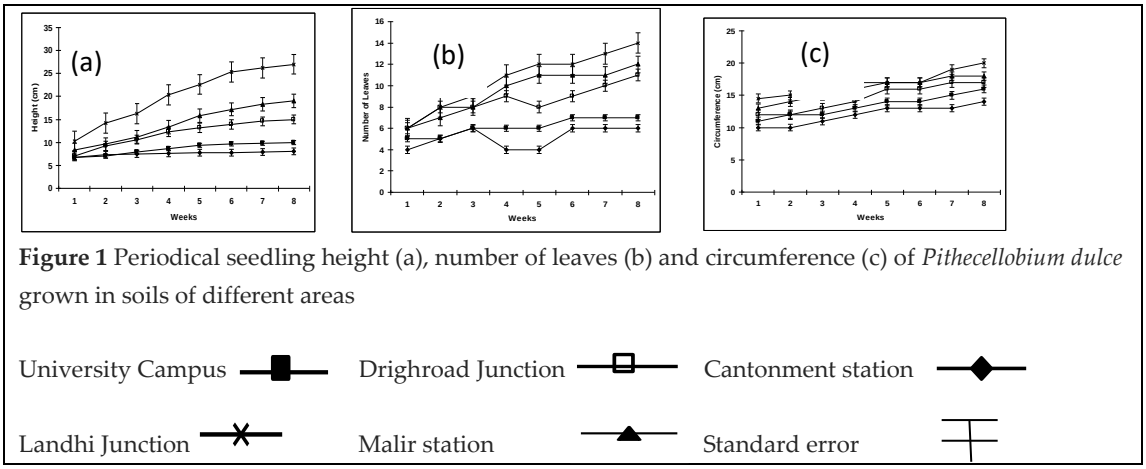

Figure 1 Periodical seedling height (a), number of leaves (b) and circumference (c) of *Pithecellobium dulce* grown in soils of different areas

The seedling height, number of leaves and circumference of *P. dulce* was found best by the soil of Landhi Junction for all weeks of surveillance. Studies finds the variation in the leaves number of *P. dulce* seedlings grown in soil of University Campus,

Cantonment, Drighroad, Malir and Landhi railway Junction was prominent. As comparison the results presents a wide difference in seedlings circumference of *P. dulce* grown in railway siding soil in all the weeks of the study.

Table 1 The growth development of *Pithecellobium dulce* in different soil

Sites	Root length cm)	Shoot length (cm)	Seedling length (cm)	No. of leaves	Leaf area (cm^2)	Cir. (cm)	Seedling dry weight (g)
A=Karachi University	6.16±0.46a	10.64±0.59a	16.80±0.80a	7.40±0.68a	2.06±0.04b	16.08±0.39b	0.412 ±0.016b
B=Karachi Cantonment	5.16±0.22a	8.84±0.67a	14.00±0.83a	6.60±0.67a	1.59±0.02a	13.92±0.22a	0.322±0.010a
C=Drighroad Station	9.04±0.52b	15.34±0.61b	24.38±1.09b	7.80±1.12b	2.38±0.04bc	17.10±0.15c	0.564±0.015c
D=Malir Station	10.02±0.19b	19.4±0.99c	29.42±1.18c	12.80±0.66bc	2.66±0.01c	18.64±0.39d	0.886±0.021d
E=Landhi Station	11.88±0.36c	27.10±1.65d	38.98±1.99d	14.80±0.58c	3.75±0.06d	20.50±0.21e	1.072±0.009e
LSD ($p<0.05$)	1.11	2.92	3.72	4.24	0.44	0.86	0.044

Mean values followed by the same letter in a row are not significantly different ($p<0.05$) according to Duncan's multiple range test.

The response for the test of seedling developmental of *P. dulce* in soil of along railway track was comparatively quite low due to ongoing activities of railways. The plant height, root, shoot and leaves number of *P. dulce* was high in soil of site E and lowest was recorded in the soil of site B (Table 1). The leaves provide the useful information about the many biochemical reactions. The yield of *P. dulce* in soil of site B was reduced significantly which might be due to low fertility. The same results explained that the reduction in leaf number and circumference of *Blepharis sindica* were suppressed due to low nutrients content in soil (Iqbal and Shafiq, 1997).

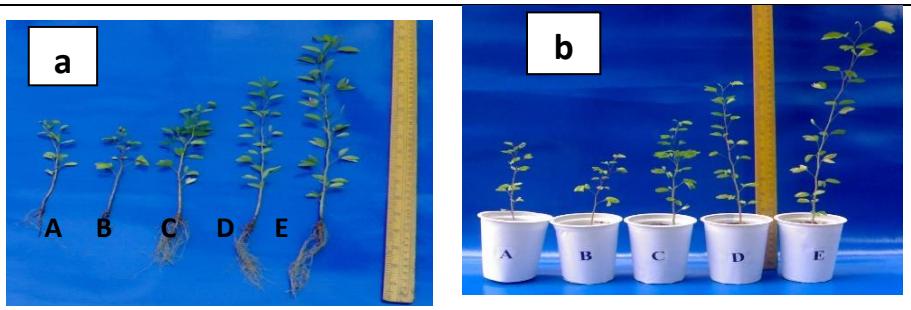

Figure 2 Growth characteristics of *P. dulce* in different soils (b) and after harvest (a) Symbol used: (Site= A-E)

The results of comparison between soil treatment lead to soil failure for development of *P. dulce* in site B. the soil of the area directly influence by railway movement. The maximum decrease in seedling dry weight of *P. dulce* based on site B soil might be due to the presence of toxic and harmful metallic element. This approach showed a consistent agreement with other researchers. The results verify the biomass production of wheat was highly affected from elevated concentrations of heavy metal (Shukla et al., 2003). From all the results predict that the germination and plants development directly depends on the some edaphic characteristics and supply of nutrient. The nutrients availability, absorbance and uptake affect plants growth which is approached by some authors (Sial, 1991; Rehman et al., 2011; Shafiq and Iqbal, 2012).

Overall, this study demonstrated the differential effects of treated soil of cantonment area on seedling development, seedling dry weights values in terms of root, stem and leaves of *P. dulce* were prominently noted. The exhaust emission, particulate matter, abrasion and wear are key element from railway activities pollute the environment and contaminate soil over the time change (Hassan and Nosheen, 2019; Vandoorne et al., 2021; Dong and Zhang, 2023; Fruhwirt et al., 2023). Additionally, developmental works, encroachment and construction of houses near railway tracks are an additional cause of change in the soil properties. Furthermore, the services of train engines and addition of diesel engine oil in site B polluted soil.

4. CONCLUSIONS

The main conclusion in this study is as follows: Locomotive exhaust emission deleteriously affected the quality of soil. The *P. dulce* seedlings in soil of the Cantonment Station find negative effects. The soil of Malir and Landhi railway station showed better and

favorable. To overcome the problem, further research and field work is required on the impact of same soil types on other new species. To increase vegetation cover for clean environment.

Author's contribution

Muhammad Zafar Iqbal supervised the experiment and Zia-Ur-Rehman Farooqi performed it. Muhammad Shafiq prepared draft and manuscript reviewed by Muhammad Kabir. All authors approved the present form of the manuscript.

Informed consent

Not applicable.

Ethical approval

The ethical guidelines for plants & plant materials are followed in the study.

Conflicts of interests

The authors declare that there are no conflicts of interests.

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Data and materials availability

All data associated with this study are present in the paper.

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